



Shorter communication

## How to project oneself without positive and integrated memories? Exploration of self-defining memories and future projections in bipolar disorder



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### A B S T R A C T

Bipolar disorder (BD) is a disabling disorder with functional impact on everyday life. Recent studies suggest that autobiographical memory impairment may contribute to the maintenance of psychopathology, leading to enduring altered self-construct. Moreover, past personal experiences also support the ability to project oneself into the future to pre-experience an event, this capacity can be modified by psychiatric disorders. Self-defining memories and future projections by accessing highly significant events that are vivid and focused on central goals or enduring concerns can both provide a better understanding of the impact of disorders on self-perception and on the ability to project oneself into the future. Therefore we proposed to explore self-defining memories and future projections in BD patients ( $n = 25$ ) compared to control participants ( $n = 25$ ). BD patients' self-defining events were associated with more tension, life-threatening events, and negative emotion. BD patients also reported less integrated past but not less integrated future self-defining events. And their future projections were more closely related to leisure, and associated with positive emotions, compared to controls. For both groups, the future projections were less specific, integrated, and tense than the memories. These results question the self-coherence of patients' identity and should be confirmed to propose appropriate interventions to project oneself adaptively into the future and contribute to a better outcome.

### 1. Introduction

Living with a psychiatric disorder may be a life-altering experience that can have detrimental effects on one's sense of self (Holm, Pillemer, Bliksted, & Thomsen, 2017). It can be associated with a loss of former self, including the goals and dreams that one once aspired to achieve (Lysaker & Lysaker, 2004), and many patients must endeavor to redefine who they are as an individual. Following diagnosis or symptoms, some individuals' self-concept becomes defined solely by the illness, leading to a progressive restriction of roles until only the patient's role remains (Estroff, 1989). Increasing evidence suggests that impaired autobiographical memory (AM) may reflect the growing presence of psychopathology into self-construct (Ricarte, Ros, Latorre, & Watkins, 2017).

AM is a cognitive function that encompasses the individual's semantic and episodic past personal experiences and that is one of the resources that supports the ability to project oneself in time to pre-experience an event (Okuda et al., 2003). AM processes associated with the sense of personal identity and continuity in one's individual history (Conway, 2004) can be more specifically explored by means of self-defining memories (SDMs) and self-defining future projections (SDFPs). SDMs are recollections of highly significant events that are vivid, emotionally intense, repetitively recalled, and focused on central goals, enduring concerns, or unresolved conflicts (Singer & Salovey, 1993). SDFPs are their future counterparts (D'Argembeau & Van der Linden, 2012) and correspond to mental representations of future events that provide core information on self-understanding.

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Bipolar disorder (BD) is a disabling disorder characterized by an alternate of episodes of depression and mania or hypomania (APA, DSM-5). It is associated with a functional impact on everyday life (Gitlin & Miklowitz, 2017). In contrast to the literature devoted to major depression or subclinical depression (Talarowska, Berk, Maes, & Galecki, 2016), only a few studies have investigated AM in this population. Results have shown a bias toward overgeneralized memories even in remitted patients (Boulanger, Lejeune, & Blairy, 2013; Bozikas et al., 2019; Kim et al., 2014) which means that patients less frequently retrieved memories of unique past events. In Quinlivan et al. (2017), there was a trend for a negative correlation of AM specificity and the residual depressive symptoms. This inability to recall specific events impacts the capacity to define oneself and also to project into possible events in the future. Accordingly, a recent meta-analysis showed less specific and detailed future self-projections in patients with BD than in the general population, with a large and homogeneous effect (Hallford, Austin, Takano, & Raes, 2018). Nevertheless, these abovementioned studies did not investigate the more narrative component of self and in particular the connection of these events with the participants' self. Self-defining events make it possible to explore these aspects and have been studied to that aim in several psychopathological populations. For example, in schizophrenia population, more life-threatening event experiences and fewer past achievements have been recalled when compared to controls; patients demonstrated also difficulties to give meaning to the self-defining events to integrate these in their life story (Berna et al., 2011; Raffard et al., 2009, 2010, 2016). Moreover, relationships can be built between self-defining events' characteristics and clinical outcomes: for example, alcohol-dependent patients tend to retrieve more negative memories than the controls, contributing to a negative perception of themselves and questioning their perceived ability to remain abstinent (Cuervo-Lombard, Raucher-Chene, Barriere, Van der Linden, & Kaladjian, 2016). No such study has been conducted in the BD population whereas this population encounters frequent ruptures in its life course due to the recurrent mood episodes, worsening the risk of identity fragmentation linked to poor memory integration (Singer, Blagov, Berry, & Oost, 2013). Nevertheless, one study (Lardi Robyn, Ghisletta, & Van der Linden, 2012) investigated SDMs and SDFPs in non-clinical individuals with hypomania proneness and showed that a history of hypomanic symptoms was related to enhanced retrieval of memories describing positive relationships and to reduced future projections about relationships. The authors interpreted those results as suggesting both a need for social bonding and a striving for autonomy in those patients. Moreover, hypomania-prone individuals tended to describe more recent events and to produce more tensed self-defining memories that were more integrated into their self-structure (Lardi Robyn et al., 2012).

However, as non-clinical individuals differ from patients with diagnosed BD, we aimed at exploring whether distinct conclusions could be drawn on a clinical sample. We, therefore, explored SDMs and SDFPs' characteristics in BD patients to provide a better understanding of the impact of this disorder on self-perception and on the ability to project oneself into the future. According to the previously described literature on AM in patients with BD or major depression and SDMs in other psychiatric disorders, we hypothesized that both SDMs and SDFPs will be less specific and integrated, and SDMs more tensed, negative, and with life-threatening content in BD population when compared to controls. We also expected differences in content between past and prospective self-defining items, as observed in the general population, with SDFPs more related to personal goals (Cole & Berntsen, 2016).

## 2. Methods

### 2.1. Participants

Twenty-five euthymic patients (16 women and 9 men) with a diagnosis of Bipolar I Disorder (i.e. having experienced at least one manic

episode) according to the DSM-IV-TR criteria (American Psychiatric Association, 2000), and 25 control participants (16 women and 9 men) matched on age and level of schooling, were included. The recruitment of the participants was conducted among the BD patients followed at the Department of Psychiatry of the University Hospital of Reims (France) and through local advertisements for controls. Patients were defined individually as euthymic when they had low scores (<8) on both the depression and mania rating scales on the Hamilton rating scale for Depression (HAMD; Hamilton, 1967) and on the Young Mania Rating Scale (YMRS; Young, Biggs, Ziegler, & Meyer, 1978). The diagnosis of BD in patients and the absence of any psychiatric condition, including BD or schizophrenia, in control participants, were assessed by a trained psychiatrist (D.R.-C) using the Mini International Neuropsychiatric Interview (M.I.N.I., French version 5.0; Sheehan et al., 1998).

We didn't include patients with any current medical or substance abuse comorbidity, as well as controls with a history of BD or schizophrenia in first degree relatives. None of the participants had a history of neurological disorders or hereditary neurological illnesses. All participants were native French speakers. Participants were interviewed individually in a quiet standardized environment. All procedures were clearly detailed to the participants by means of both oral and written information. In particular, participants were told that they would have to write down important personal memories and to fill out written questionnaires. They were also informed that any identity or personal information will be coded to ensure confidentiality of the collected data. This research was conducted in accordance with the Helsinki Declaration and was approved by the regional ethics committee (CCP Est-3, French National Regulatory Authority, N°2012-A00875-38). All participants gave their written informed consent before inclusion in the study.

### 2.2. Material

#### 2.2.1. Self-defining memories and self-defining future projections

Three SDMs were collected using the Self-defining memory task (Singer & Blagov, 2002; Thorne & McLean, 2001) as in our previous work (see Cuervo-Lombard et al., 2016 for more details), and three SDFPs were collected using an adaptation of the SDM task developed by D'Argembeau et al. (2012). Both tasks were presented with an oral definition of a self-defining event, which explained that they are personal events (memories or future events) with certain specific attributes: (1) the temporal distance from the presence of a self-defining event should be at least 1 year, (2) a self-defining event should be important and vividly represented, (3) it should be an event that helps oneself and significant others to explain who one is as an individual, (4) it should be an event related to an important and enduring theme, issue, conflict, or concern from one's life and linked to other events sharing the same theme, (5) it could be either a positive or a negative event; the only important aspect is that it generates strong feelings, (6) it should be an event that participants have thought about many times. While listening to this description, participants had a sheet of paper in front of them summing up the principal points. Subsequently, participants were asked to describe three SDMs and three SDFPs, including a caption for each of them with as many details as possible. Time was not limited. They were asked to write down a title or sentence to summarize each of the events. Thereafter, participants had to rate on a 7-point rating scale (from -3 = very negative to 3 = very positive, 0 = neutral) their emotional response while remembering/imagining the event, to establish the valence (i.e., positive, neutral, or negative) and the emotional intensity (i.e., absolute value of the rating) of the affective response. For emotional intensity, the lower scores mean less intense events, and higher scores mean more intense ones. Finally, they had to estimate the temporal distance of the event from the present (in years and months), to obtain a measure of the time frame (months between the event described and the retrieval day) for each SDM and each SDFP.

### 2.3. Scoring

#### 2.3.1. Specificity

A memory was coded as specific (score = 1) if the described event happened at a particular place and time and lasted less than a day (Williams & Broadbent, 1986). Nonspecific (score = 0) SDMs or SDFPs included categorical (repeated similar events) and extended (events that are longer than a day) memories.

#### 2.3.2. Integrative meaning

Narrative integrative meaning of SDMs or SDFPs was coded considering the assessment of what the event taught the participant about himself or herself, someone else, or life in general (Singer & Blagov, 2002). An event was integrated if the individual stepped back from the event narration and added a statement or comment giving significance or meaning to the event. In contrast, if the narration was purely descriptive, it was considered as non-integrative.

#### 2.3.3. Tension

SDMs and SDFPs were also coded for the presence or absence of tension, which is defined as an explicit reference to a discomfort, disagreement, or unease during the narration of the event (Thorne & K C Lawrence, 2004).

#### 2.3.4. Content

The content of an SDM or SDFP was evaluated using the classification proposed by Thorne and McLean (2001). Contents were distinguished in seven categories, depending on the content of the recalled event: life-threatening, recreation, relationships, achievement/mastery, guilt/shame, drug/alcohol abuse, and not classifiable. As other studies on SDMs in patient population, we decided to add a specific category for events related to some aspect of the illness (bipolar disorder).

#### 2.3.5. Reliability

Each SDM and SDFP was independently scored by two raters (C.C-L.; D.R-C.) for specificity, meaning-making, tension, and content. In the few cases where the two ratings differed, the final rating was discussed and agreed by the two raters. The kappa interrater reliability coefficient was 0.96 for specificity, 0.90 for integrative meaning, 0.95 for tension coding, and 0.87 for content.

### 2.4. Statistical analyses

For sample size estimation, we conducted a priori analyses with G\*Power program (Faul, Erdfelder, Lang, & Buchner, 2007) to compute the required sample size. We used the expected large effect size on the integration characteristic ( $d = 0.8$ ) with a level of significance  $\alpha$  set at 0.05 and a power calculated at 80%. The total required sample size was estimated at 42 participants, 21 in each group, assuming a one-sided test. This result is consistent with the literature on SDM in psychopathological populations with mean recruitment of 20–29 participants in each group (Berna et al., 2011; Crane, Goddard, & Pring, 2010; Cuervo-Lombard et al., 2016; Holm et al., 2017; Raffard et al., 2009, 2016; Werner-Seidler & Moulds, 2014).

Statistical analyses were performed using Bayesian methods (Vandekerckhove, Rouder, & Kruschke, 2018) as it is more and more recommended in science in general and in experimental psychology in particular. Bayesian statistics provide a distribution of the probability that (in our case) the performance of patients is lower than that of controls.

Sociodemographic variables were compared between groups using univariate linear or logistic regression analyses. Characteristics of SDM and SDFP were analyzed with multilevel linear (for age, time distance, and intensity) or logistic regression (for all other parameters) analyses using self-defining items as level 1 and participant as level 2. Predictor variables included time (past vs. future), and group (patients vs.

controls). The probability related to each factor is written  $Pr(P > C)$  (i.e., the probability that patients' scores are higher than controls' ones) and is written  $Pr(OR > 1)$  for interactions. We considered both large values (i.e.,  $>0.95$ ) and small values (i.e.,  $<0.05$ ) of  $Pr$  as reflecting meaningful effects of the factor under consideration, given that  $Pr(P > C) = 0.95$  is equivalent to  $Pr(C > P) = 0.05$ .

Based on previous data (Berna et al., 2011; Raffard et al., 2010, 2016), we used informative priors for the group to analyze valence, specificity, integration, and content variables. Informative priors for the time were used based on D'Argembeau et al. (2012) study to analyze valence, specificity, integration variables.

### 3. Results

Patients and controls did not differ according to age, gender, and level of schooling. Clinical characteristics are presented in Table 1. Descriptive characteristics of SDMs and SDFPs for each group (BD and controls) are shown in Table 2 and the respective frequency of SDMs' and SDFPs' contents in Table 3.

Specificity did not differ between groups ( $OR = 0.513$ ,  $CI95\%: 0.174-1.475$ ,  $Pr(P > C) = 0.105$ ) and was less frequent in SDFP than in SDM ( $OR = 0.058$ ,  $CI95\%:0.020-0.147$ ,  $Pr(SDFP > SDM) < 0.001$ ). There was no relevant group by time interaction ( $OR = 0.610$ ,  $CI95\%:0.109-2.837$ ,  $Pr(OR > 1) = 0.268$ ).

Patients had less integrated self-defining items than controls ( $OR = 0.512$ ,  $CI95\%:0.237-1.080$ ,  $Pr(P > C) = 0.039$ ) and integration was less frequent in SDFP than in SDM ( $OR = 0.331$ ,  $CI95\%:0.156-0.611$ ,  $Pr(SDFP > SDM) < 0.001$ ). The difference between groups was meaningful for SDM ( $Pr(P > C) = 0.049$ ) but not for SDFP ( $Pr(P > C) = 0.785$ ) as revealed by the interaction between group and time ( $OR = 2.641$ ,  $CI95\%:0.998-7.059$ ,  $Pr(OR > 1) = 0.975$ ) (Fig. 1).

Tension was more frequent in patients' self-defining items ( $OR = 2.880$ ,  $CI95\%:1.105-7.905$ ,  $Pr(P > C) = 0.984$ ) than those of controls and less frequent in SDFP than SDM ( $OR = 0.056$ ,  $CI95\%:0.012-0.198$ ,  $Pr(SDFP > SDM) < 0.001$ ). There was no relevant group by time interaction ( $OR = 0.551$ ,  $CI95\%:0.080-3.843$ ,  $Pr(OR > 1) = 0.271$ ).

In the patients' group, we also checked if the frequency of specific, integrated, or tensed items was correlated to the presence of sub-syndromal mood symptoms (depressive or hypomanic), but found no meaningful correlation (specificity:  $r = -0.21$ ;  $Pr(r > 0) = 0.13$ ; integration:  $r = 0.13$ ;  $Pr(r > 0) = 0.75$ ; tension:  $r = 0.003$ ;  $Pr(r > 0) = 0.50$ ).

Regarding content, events related to life-threatening events were more frequent in patients than in controls ( $OR = 2.356$ ,  $CI95\%:1.065-5.410$ ,  $Pr(P > C) = 0.978$ ) and less in SDFP than in SDM ( $OR = 0.088$ ,  $CI95\%:0.018-0.315$ ,  $Pr(SDFP > SDM) < 0.001$ ). In contrast, events related to leisure and events not otherwise classified were more frequent in SDFP than in SDM ( $OR = 17.75$ ,  $CI95\%: 4.86-90.41$ ,  $Pr(SDFP > SDM) > 0.999$  and  $OR = 2.102$ ,  $CI95\%: 0.955-4.767$ ,  $Pr(SDFP > SDM) = 0.968$ , respectively) and events related

**Table 1**  
Socio-demographic and clinical data in each group (BD: patients with bipolar disorder; C: control participants).

	BD		C		Pr (BD > C)
	Mean	SD	Mean	SD	
Age (years)	37.68	12.78	37.24	12.23	.902
Level of schooling (years)	12.36	2.56	12.44	2.48	.911
Verbal IQ estimation	88.72	18.01	93.08	14.75	.354
HAM-D score	3.16	2.43	1	1.76	<b>.001</b>
YMRS score	1.68	2.49	-	-	-
Age of onset (years)	23.08	10.49	-	-	-
Hospitalisations (nb)	4.24	3.37	-	-	-
Depressive episode (nb)	3.96	3.67	-	-	-
Suicide attempts (nb)	1.48	2.35	-	-	-
Manic episode (nb)	2.68	1.43	-	-	-

HAM-D: Hamilton rating scale for Depression; YMRS: Young Mania Rating Scale.

**Table 2**

Descriptive characteristics of SDM and SDFP for each group (BD: bipolar disorder patients; HC: healthy controls).

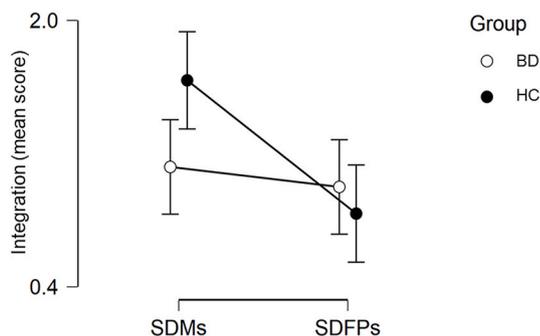
	SDM				SDFP			
	BD		HC		BD		HC	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Specificity <sup>a</sup>	1.28	1.17	1.72	1.10	.16	.62	.36	.70
Meaning making <sup>a</sup>	1.12	.88	1.64	1.11	1.00	.95	.84	.68
Tension <sup>a</sup>	1.44	1.16	.84	.75	.16	.37	.04	.20
Time frame (months)	171.36	116.76	176.52	114.60	31.92	44.04	61.32	39

<sup>a</sup> mean number of self-defining events on the 3 collected.

**Table 3**

Percentage of categories of contents as proposed by Thorne and McLean (2001) in each group (BD: bipolar disorder patients; HC: healthy controls).

	% SDM		% SDFP	
	BD	HC	BD	HC
Life-threatening	32	22.67	2.67	1.33
Recreation	2.67	1.33	14.67	24
Relationships	36	48	28	22.67
Achievement/mastery	10.67	14.67	22.67	26.67
Guilt/shame	2.67	2.67	0	0
Drug/alcohol abuse	0	0	1.33	0
Not classifiable	12	10.67	29.33	25.33



**Fig. 1.** Mean scores for integration in SDMs and SDFPs in each (BD: bipolar disorder; HC: healthy controls).

to relationship were less frequent in SDFP than in SDM (OR = 0.337, CI95%: 0.165–0.670,  $Pr(SDFP > SDM) < 0.001$ ). The frequency of leisure, achievement and relationship events did not differ between groups ( $Pr(SDFP > SDM) > 0.111$ ). There was no relevant group by time interaction.

Patients had more negative self-defining items than controls (OR = 3.522, CI95%: 1.647–7.940,  $Pr(P > C) > 0.999$ ) and SDFP were more positive than SDM (OR = 0.046, CI95%: 0.010–0.153,  $Pr(SDFP > SDM) < 0.001$ ). There was no relevant group by time interaction. Regarding emotion intensity, the regression analysis used the absolute value of emotional intensity (ranging from 1 to 3) as dependent variable and group, time and valence (positive vs. negative) as predictors. Results showed that emotion intensity did not differ between patients and controls (OR = 1.014, CI95%:0.560–1.818),  $Pr(P > C) = 0.520$  nor between SDM and SDFP (OR = 1.225, CI95%:0.236–7.656),  $Pr(P > C) = 0.592$  and was slightly higher for positive than negative memories but the difference was not meaningful (OR = 1.498, CI95%:0.848–2.638),  $Pr(P > C) = 0.919$ ). No meaningful interaction was observed.

The temporal distance between the present time and the time of self-defining items was lower for SDFP than for SDM (M = -0.927, CI95%: -1.193-0.660,  $Pr(SDFP > SDM) < 0.001$ ) but did not differ between groups ( $Pr(P > C) = 0.260$ ). The age of participants at the time of the event did not differ between groups ( $Pr(P > C) = 0.772$ ) but was of course greater for the future than the past items. For both temporal

distance and age, no interaction between time and group was observed.

### 3.1. Complementary and sensitivity analyses

Complementary analyses were performed in order to explore the role of residual depressive symptoms on group differences. In all analyses showing a meaningful group difference (integration, tension, valence), the HAMD score reflecting the level of depressive symptoms was entered in the regression analyses. Depressive symptoms predicted integration, marginally valence, not tension but all main effects and interactions remained unchanged, meaning that depressive symptoms could not account for the observed group differences. More precisely, the intensity of depressive symptoms was positively associated with integration ( $\beta = 0.366$ , CI95%:0.044–0.694,  $Pr(\beta > 0) = 0.988$ ). However, the main effects of group (OR = 0.367, CI95%:0.153–0.847,  $Pr(P > C) = 0.009$ ), of time (OR = 0.296, CI95%:0.142–0.595,  $Pr(SDFP > SDM) < 0.001$ ), and the interaction between group and time remained unchanged (OR = 2.676, CI95%:1.003–7.620,  $Pr(OR > 1) = 0.976$ ). Tension was not influenced by depressive symptoms ( $\beta = -0.012$ , CI95%: 0.497 to 0.477,  $Pr(\beta > 0) = 0.480$ ) so that the main effects of group (OR = 3.117, CI95%:0.998–10.810,  $Pr(P > C) = 0.974$ ), and of time (OR = 0.020, CI95%:0.001–0.122,  $Pr(SDFP > SDM) < 0.001$ ) remained unchanged. The group by time interaction was still not relevant ( $Pr(OR > 1) = 0.606$ ). Depression had a marginal influence on the valence of self-defining items ( $\beta = -0.315$ , CI95%: 0.113 to 0.766,  $Pr(\beta > 0) = 0.926$ ) but did not alter the effect of group (OR = 3.009, CI95%:1.107–9.169,  $Pr(P > C) = 0.984$ ) nor the effect of time on valence (OR = 0.013, CI95%:0.001–0.080,  $Pr(SDFP > SDM) < 0.001$ ). There was still no relevant group by time interaction ( $Pr(OR > 1) = 0.743$ ).

Considering that the informative priors that we used may have influenced the results in the direction of our expected effects and in order to test the robustness of our results, sensitivity analyses were performed firstly using non-informative priors and secondly using pessimistic priors for the group and time factors. For instance, if the literature suggests that patients have twice less integrated SDM than controls, informative priors will include this value in the analyses. In contrast, non-informative priors consist in considering that there is no a priori difference between groups, and pessimistic priors consist in considering that patients have twice “more” integrated memories than controls (i.e., the prior goes now in the opposite direction as the expected effect). Results showed that for integration, the group difference was no longer relevant using non-informative and pessimistic priors ( $Pr(P > C) = 0.063$  and  $0.094$  respectively) whereas the effects of time and the interaction remained unchanged. All other results unchanged suggesting that the estimations of coefficients were mostly driven by the data we collected and not by the expected results.

## 4. Discussion

To the best of our knowledge, our study is the first to explore SDMs and SDFPs’ characteristics in patients with BD compared to control participants. Our results showed that BD patients reported more tensed and life-threatening self-defining events. Emotions related to the self-defining events were also more negative in the BD group than in the

control one. Interestingly, BD patients reported less integrated past but not less integrated future self-defining events. Furthermore, our results confirmed particular characteristics of SDFPs that differed from SDMs but similarly in both groups. Namely, SDFPs were less specific, integrated, and tensed than SDMs. SDFPs were also more related to leisure and less to relationships or to life-threatening events, and more positive when compared to SDMs.

First of all, self-defining events were less integrated into bipolar patients' memories than in controls, and the difference between groups was only significant for SDMs. Indeed, the integration of SDFPs was low in both recruited populations (patients and controls) without a significant difference between the two groups. Integration refers to the participant's stepping back from the event to determine a higher personal meaning or a life lesson (Blagov & Singer, 2004). And this ability to link events to abstract self-knowledge constitutes a positive loop that reinforces the value of the event and contributes to a self-coherent representation of oneself (Blagov & Singer, 2004). Impaired integration of the self-defining events has been shown in schizophrenia, in both spontaneous and cued conditions (Berna et al., 2011; Raffard et al., 2009, 2010). These studies on the clinical population suggest that this impairment does not only correspond to a greater tendency to relate events rather than their consequences, but a true inability to make meaning (Berna et al., 2011). And this inability can be related to social exclusion, the traumatic context of the event, or patients' symptomatology (Berna et al., 2011). In a study conducted on non-clinical individuals with a propensity to hypomania, the integrated meaning of self-defining events was not related to proneness to hypomania (Lardi Robyn et al., 2012). And we did not find in our study any correlation either between the subsyndromal mood symptoms of the BD patients and self-defining events characteristics. Contrary to our hypothesis, no difference in meaning-making was found for SDFPs between the two groups. Our control group had less integrated projections than memories and this result is in contrast with the study from Demblon et al. (2017) displaying more integrated SDFPs than SDMs. One potential explanation of this discrepancy is the age of the control population recruited as many studies on the general population and self-defining events have been conducted on students' population and not on middle-aged participants (Rathbone, Conway, & Moulin, 2011; Sutin & Stockdale, 2011). Another potential explanation for this result is that participants may have elicited personal semantic responses for SDFPs (Renoult, Davidson, Palombo, Moscovitch, & Levine, 2012). Indeed, thinking about the future is not only based on an episodic simulation process, but may also rely on more abstract mental representations (Gilead, Trope, & Liberman, 2018). The SDFPs could be based on the knowledge of the participant's past, and thus be highly personal while being decontextualized. Thus, these projections might be at the intersection of semantics and episodic memory; the expected link between projected events and meaning-making would then not be established, resulting in poor integration in both groups. For SDMs, our results on BD extend previous ones obtained for SDMs in other symptomatic populations, confirming meaning-making impairment. Without the ability to take distance from negative or life-challenging events (J. A. Singer et al., 2013; Waters, Kober, Raby, Habermas, & Fivush, 2019), this impairment probably has serious consequences, both in terms of the sense of personal identity and in terms of social adaptation. If the integration of self-significant events is deficient, one may assume that the experience of BD mood episodes is likely to question the anterior goals, beliefs, or global self-coherence of patients. By providing discomfort, tension found in self-defining events provided by BD patients can also reinforce this risk of fragmentation of the self (Mansell & Hodson, 2009). This fragmentation could be comforted by the mood episodes that cause disruptions in everyday functioning. It would also contribute to the maintenance of the psychopathology, with poor integration of the disorder leading to poor medication adherence and a higher risk of mood episodes' recurrence. This relationship can be conceptualized as a loop that increases the burden of the disorder over time. Furthermore, more events selected by patients with BD as

self-defining were life-threatening when compared to controls. This can be linked to possible trauma experienced in their past, a result that aligns with previous studies in similar populations with either affective or psychotic disorders (Aldinger & Schulze, 2017; Berna et al., 2011; Biedermann et al., 2017; Raffard et al., 2010). However, these negative characteristics of the self-defining events observed in our BD group could be the starting point for interventions to improve BD outcomes. For example, working on the meaning-making process of negative events with narrative psychotherapy can lead to resolve central conflicts in relation to the disorder and produce positive affective effects (Ricarte et al., 2017; Jefferson A; Singer, 2005; Yanos, Roe, & Lysaker, 2011). Besides, mental imagery can be related in theme and content to self-relevant memories and become distressing or intrusive in psychopathological conditions (Mansell & Hodson, 2009). In BD, a strong role of imagery has been suggested in driving emotional instability (Holmes et al., 2011). Imagery rescripting, a cognitive-behavioral technique that aims to modify the meanings associated with negative or traumatic memories, can also facilitate the integration of adverse SDMs and reduce their negative impact on self-esteem and self-representation (Cili, Pettit, & Stopa, 2017).

Surprisingly, we found no relevant difference in specificity between our two groups. On a different task requiring to generate specific past and future events in response to positive and negative cues words in a BD population, Boulanger et al. (2013) recollected fewer specific past negative events and fewer future specific positive and negative events than in the control group suggesting that BD population have an over-general memory style. But even if impaired specificity of autobiographical memory is commonly found in people presenting with psychiatric disorders, it might be different for SDMs. For example, a meta-analysis conducted on schizophrenia populations showed that large effect-size impairments for specificity in AM were found, whereas no difference was revealed between the groups for SDMs (Berna et al., 2016). This discrepancy might be partially explained by the task itself as contrary to most of the usual AM tasks, the SDM protocol does not require participants to recall unique events. Participants are rather asked to recall events important for themselves.

These important events reported are also requested to be emotionally strong (Singer & Blagov, 2002). In our participants, we found a temporal difference with more positive SDFPs than the SDMs but no difference in intensity. In a study exploring the phenomenology of SDFPs, envisioned events had also a high positive valence (D'Argembeau & Van der Linden, 2012). Positive events are judged to be more central to identity than negative ones (Berntsen, Rubin, & Siegler, 2011), and the valence of emotion contributes to the organization of future thoughts with a direct impact on well-being (Demblon & D'Argembeau, 2016). In our BD group, self-defining events were reported as more negative by patients than by controls. In schizophrenia, the richness of emotional details in personal memories is weaker (Berna et al., 2016), and a negative bias has been found in a population with psychiatric disorders (Biedermann et al., 2017; Raffard et al., 2009) suggesting a failure to integrate positive events in memory consolidation processes (Herbener, Rosen, Khine, & Sweeney, 2007). The temporal distinction between past and future events in the BD group wasn't significant in our study. In a different study conducted on BD, patients felt more emotional intensity related to future events (Boulanger et al., 2013). And this should be discussed in light of another study investigating SDFPs in schizophrenia (Raffard et al., 2016). Indeed, despite those patients had difficulties in reflecting on the broader meaning and implications of imagined future events, a large majority of SDFPs in schizophrenia patients were positive events, including achievements, relationships, and leisure contents. Interestingly, patients and controls did not differ on the perceived probability that these events will occur in the future suggesting that schizophrenia patients have an exaggerated positive perception of their future selves (Raffard et al., 2016). This hypothesis might also be relevant to BD populations as leisure content is present without a significant between-group difference in SDFP in our study. By approaching the

control group in their themes and emotional perception of the future, BD patients might create an idealized representation of one's future potential in the face of stress and adversity caused by the disease. It remains here to be shown whether this representation is helpful for the patients or is non-realistic and might contribute to the loss of self-coherence. SDFPs are poorly integrated in all participants, and the contrast between past and future self-defining items may thus contribute to having difficulties to project oneself into the future. One of the main risks is to conceive unreachable personal goals that could reinforce low self-esteem (Liao, Bluck, & Westerhof, 2017), but also contribute to the development of hypomania symptoms, like grandiosity and hyperactivity (Johnson & Carver, 2006).

Our study has some limitations that need to be addressed such as the small number of participants that restrains the generalization of our findings. However, except for the group differences on integration, all other results remained robust in spite of the use of non-informative and even pessimistic priors. One may also question the potentially detrimental effect of medication on memory in BD patients (Cullen et al., 2019), however existing AM studies on depression did not find any relevant effect of psychotropic drugs (Biedermann et al., 2017). Another limitation of our study is the absence of data on global functioning that would also have been of interest in this clinical BD population to link these self-defining items' changes to everyday life impact.

In conclusion, our study demonstrated some specific characteristics of BD patients' self-defining items. BD patients reported less integrated and emotionally intense events, but also more tensed and negative than the control group. These specificities may contribute to the difficulty for the patients to use their personal history to project themselves adaptively into the future as personal identity is not only nourished by representations of significant past and future events but also depends on the formation of coherent networks of related events that provide an overarching meaning to specific life experiences (Demblon & D'Argembeau, 2017). These results should be confirmed to propose a personalized psychological intervention to improve insight and self-coherence.

## Author contribution

DRC: Conceptualization, Investigation, Writing - Original Draft, Funding acquisition.

FB: Formal analysis, Writing - Review & Editing.

KV: Investigation, Writing - Review & Editing.

SB: Resources, Project Administration.

MVDL: Conceptualization, Methodology; AK: Supervision, Funding acquisition.

CCL: Conceptualization, Investigation, Writing - Review & Editing.

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